CHARACTERIZATION OF MICROPLASTICS AND ECOLOGICAL RISK ASSESSMENT IN FRESHWATER SYSTEM, DHURWA DAM

BY

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SYNOPSIS

SUBMITTED TO

UNIVERSITY DEPARTMENT OF GEOLOGY,

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1. INTRODUCTION

As plastic materials are being produced and used more extensively in our daily routines, significant quantities of them have been discharged and amassed in the surroundings. People, we have become a throw-away society.

Plastics degrade over time but never go away. They break up into smaller and smaller pieces, eventually becoming microplastics and microscopic nano plastics. Microplastics are bits of plastic less than 5mm in size. They are found in every ecosystem on Earth and consist of microbeads, microfibers, and broken-down pieces of plastic.

Microbeads are tiny abrasives, usually polyethylene, found in wash-off cosmetics, cleansers, and toothpaste. Microfibers are tiny pieces of threads and fibers that break off clothing. Clothing made from plastic (nylon, polyester, rayon, acrylic, and spandex) sheds microfibers with every wash. These microfibers and microbeads go down the drain into sewer systems. Wastewater treatment plants are not designed to remove all particles. Therefore, microplastics can be discharged into waterways through wastewater effluent. If the microplastics are removed during the treatment process, they can remain in the sewage sludge that may be applied as fertilizer on agricultural fields. They can still end up in the environment, entering waterways through runoff. Microplastics have been lurking around in every little corner of the environment, including air, soil and water. Oceans, freshwater and water in the polar region are some of have been all found to contain high amounts of these toxic particles.

Microplastic contamination has been found in natural freshwater systems, including wetlands, lakes and rivers around the globe which favour the accumulation of microplastics, causing far-reaching implications for the ecosystem. Microplastics can leach chemicals into the environment. However, an even greater danger, they attract and concentrate heavy metals and organic pollutants dissolved in the water.

1.1 STATE OF THE ART

The area under investigation is Dhurwa Dam which is a reservoir dam on the Subarnarekha River in Ranchi district, Jharkhand, India (23.2898° N, 85.2490° E). It was constructed in the 1960s and is operated by the Ranchi Municipal Corporation. The dam provides water for drinking water to the city of Ranchi and for irrigation in the surrounding areas.

Hatia Water Supply System: The Hatia water supply system has a treatment capacity of 56.83 MLD and its water is sourced from the Dhurwa Dam with a basin area of 47.9 km2 located in the Subarnarekha River, which is southwest of Ranchi city. It was commissioned in 1963 to serve water to the heavy engineering corporation industrial area and population in the southern part of the city.

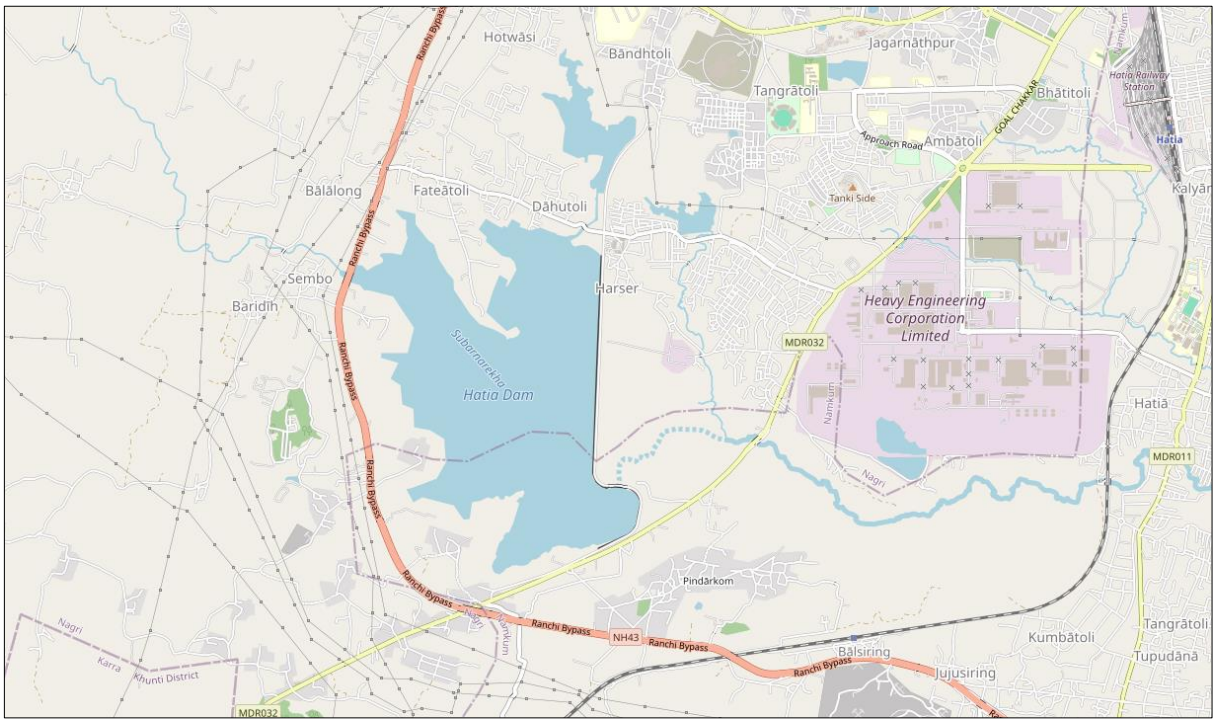

Fig: Dhurwa Dam Topographic Map

2. PROBLEM TO BE INVESTIGATED

Microplastics can enter freshwater systems through various pathways, such as runoff from land, wastewater discharge, or atmospheric deposition. Microplastics in freshwater and drinking water have become a growing concern in recent years due to their potential impacts on human and environmental health. Studies have shown that microplastics can accumulate in aquatic organisms, including fish and other wildlife, which can lead to negative health effects.

Freshwater, reservoir water, surface water, and groundwater are some examples of drinking water sources that have been contaminated by unauthorized waste disposal or other anthropogenic activity. Wastewater combined with surface water is also used as a source of drinking water plants in many parts of the world. Due to discharges from raw water treatment

facilities (WTP), microplastics can enter freshwaters and finally reach drinking water. Since raw water that has been mixed with surface water is regarded as a source of drinking water, it is crucial to evaluate how well treatment procedures are working. Implementing the removal of microplastics from drinking water will need significant work.

The present study shows the degradation of quality of freshwater systems in terms of occurrence and abundance of microplastics in surface water and sediments of freshwater systems, which leads to degradation of drinking water quality. Its ecological impacts on the environment represent a looming threat that needs to be critically examined.

3. OBJECTIVE TO BE INVESTIGATED AND MOTIVATION

Microplastics are a widespread environmental contaminant that raises serious concern for aquatic organisms. Therefore, there is an urgent need to investigate the impact of Microplastic bioaccumulation.

This study focuses on the quantification and morphological characterization of microplastics in Dhurwa dam. This lake serves as a primary water resource for water consumption for huge settlements in the Ranchi city.

Further aims are to review data on concentration, polymer type, shape and size distribution data across studies, seasonal variation of microplastics.

This research will provide valuable insights into risk assessment to the ecological system caused by concentration of such microplastics.

The manuscript focuses on the increasing concern of microplastics in freshwater environments, their sources, occurrence, and potential impacts on human health and aquatic ecosystems. This study discusses various techniques used for the detection, characterization, and quantification of microplastics in water. It also covers the potential negative impacts of microplastics on the environment and human health, and the processes that drinking water treatment plants can use to eliminate microplastics from water.

4. RESEARCH DESIGN AND METHODOLOGY

The proposed approach for the research study is as follows:

The sampling is done with the help of Manta net, fabricated using mesh size of 125µm within the study area and sediments were collected with the help of trowel.

The trapped particles in Manta net were collected and sieved through 63µm sieve.

The raw sample was purified using H_2O_2 in presence of Fenton's reagent which acts as catalyst, followed by density separation using NaCl. The supernatant was collected on filter paper and quantified using stereomicroscope (fluorescence microscopy).

The chemical nature of the collected microplastics was identified using FTIR technique.

Polymer identification

To assure reliable assessment of plastic particles, the polymer identity needs to be confirmed, preferably by using (micro) FTIR or Raman spectroscopy, pyrolysis-GCMS or TGA-GCMS techniques.

5. TOOLS TO BE USED IN THE COLLECTION OF DATA

1. Manta net fabricated using mesh size of 125µm.
2. Manta net size 63µm for sieve
3. Trowel
4. Aluminium foil for sample collection

6. SIGNIFICANCE OF THE STUDY

ITS RELEVANCE TO THE PRESENT-DAY PROBLEM AND NEED OF THE SOCIETY

Firstly, microplastics are relatively stable in the environment and are not easy to degrade, causing serious harm to the environment and organisms. In addition, a series of changes may occur to microplastics in the environment, resulting in the release of some plastic additives with biotoxicity into the environment and the formation of secondary pollutants.

Microplastics have a strong ability to migrate in the environment due to the small particle size of microplastics.

Identification of the chemical nature of the microplastics indicates their probable sources and thus can be a useful tool to minimize the abundance by source correction.

7. CONTRIBUTION TO THE EXISTING KNOWLEDGE, FUTURE WORK

For the treatment of microplastic pollution- some composite materials have been synthesized recently to catalyse the degradation of microplastics or to synthesize degradable and environmentally friendly polymers which are of great benefit to the treatment of microplastic pollution.

It discusses the policies and regulations available in different countries to design an effective global policy.

The creation of legal restrictions at a government level.

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